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PATENT SPECIFICATION

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(54) HEAVY-DUTY EXCHANGEABLE PACKING FOR COLUMNS

(71) We, VEB MASCHINEN UND APPARATEBAU GRIMMA, a Corporation organised under the laws of Eastern Germany, of 3—5 Bahnhofstrasse, Grimma, Germany, do hereby declare the invention, for which we pray that a patent may be granted to us, and the method by which it is to be performed, to be particularly described in and by the following statement:—

The present invention relates to a heavy-duty exchangeable packing for columns, the insert elements of which consist of perforated sheets and in multiple combination serve to produce an intensive contact between gas or vapour and liquid. The use of the heavy-duty exchangeable packing is possible predominantly in columns in which large volumes of gas or vapour must be put through with very low pressure losses, for example in columns working *in vacuo* for rectification, or in columns in which extreme liquid loadings are present, or in the case of gas moistening or drying, direct heat exchannge, for separation purposes and the like.

A packing is known which consists of a single-layer perforated material of such arrangement that a cellular structure is produced. The cells have inclined walls and openings therein which can just be closed by the liquid without gas charging. Expanded metal is expediently used, the webs of which extend substantially horizontally. The openings are so formed that the gas is compelled suddenly to change direction.

In the case of this packing, great gas or vapour throughputs are realisable only in the case of small loading width and small separation action by reason of the considerable size of the cells. In addition due to the size of the cells an entrainment of liquid into higher cells occurs. Thus remixing occurs and as a result the separation effect is deteriorated. To achieve a pre-calculated separation task, using this packing, a great column height becomes necessary. Moreover, only small liquid loadings are possible since in the case of great quantities of liquid the liquid cannot be conducted on the cell walls, which results in a separation-effect-reducing sprinkling through with irregular gas/vapour-liquid distribution. By reason of the size of the cells the packing is extremely unstable. The constructional assembly of the individual elements necessitates additional retaining constructions.

A further known vapour-liquid contact device consists of a plurality of structural members which are assembled to form a lattice element of any desired size. The structural members are arranged fundamentally horizontally. Each member is here provided with several mutually separate reinforced ribs and with openings. These openings extend both into the horizontal and into the vertical part of the member and are separated from one another by narrow webs.

This contact device has the same disadvantage as already explained for the packing stated above, that is to say it does not guarantee an adequate separating effect. The reason for this is that the gas/vapour phase cannot come adequately into contact with the liquid phase due to the presence only of large openings. No intensive eddying of the gas or vapour and liquid phases occurs. The liquid itself sprinkles through almost unhindered over relatively large sections, even in the case of staggered arrangement of the openings. Since no self-wetting material is used, the full cross-section of the webs of the lattice elements cannot be used for the substance exchange and a continuous contact area renewal.

One decisive economic disadvantage of the contact device is the high material consumption which occurs due to the great cutting to waste necessitated by the openings.

According to the present invention there is provided heavy-duty exchangeable packing for gas or vapour and liquid contact columns, comprising layers of horizontally arranged parallel insert elements which are perforated, bent sheets having sheet portions at an angle to each other, the layers of sheets being packed one above the other in layers, the perforations being elongated along an axis and being orientated in direc-

tion on each sheet, either all in the same direction of orientation or in different directions of orientation the sheet portions being provided with flaps cut therefrom, the flaps being bent from the plane of their respective sheet portions in similar directions at similar acute angles, whereby additional passage openings are produced in the sheet, the additional passage openings being provided so that the flaps for each sheet portion point in the same direction wherein the direction or directions of orientation of the perforations on one sheet is different from the direction or directions of orientation of the perforations on the next adjacent sheet.

A heavy duty exchangeable packing may therefore be provided which is economical as regards material consumption, production and assembly, and which ensures a good separating effect with the most various loadings, great loading width and low pressure loss.

There may be provided also an intimate contact between fluid phases by appropriate alignment and design of passage openings for gas/vapour and liquid in and between the packing elements.

With this heavy-duty exchangeable packing a self-supporting column packing has been provided which by reason of the selection of the sheet material and its processing and arrangement can be most extensively adapted to the most various separation tasks or loading ranges while providing the excellent separation effect and low-pressure losses. This wide adaptability is achieved without additional expenditure for sheet material, without any cutting to waste and without additional tools.

The invention is now explained in greater detail hereinafter by reference to a series of examples of embodiment.

In the accompanying drawings:—

Figures 1 to 5 show examples for forms of the bent sheet insert elements in perspective view,

Figure 6 shows part of an insert element in perspective view,

Figure 7 shows a detail X of Figure 6,

Figure 8 shows the section A—A of Figure 7,

Figure 9 shows the arrangement of several insert elements according to Figure 6 side-by-side, in perspective view,

Figure 10 shows the section B—B of Figure 9 with illustration of the orientation of direction of the perforations,

Figure 11 shows the section C—C of Figure 9,

Figure 12 shows a detail of a packing in perspective view, consisting of several mutually staggered insert elements lying side-by-side and one above the other,

Figure 13 shows a further detail of a packing in a perspective view with a different form of the insert elements and additional passage openings,

Figure 14 shows details of a packing with another arrangement of additional passage openings and another arrangement of the insert elements.

The invention comprises a packing which is assembled from a plurality of insert elements 1. The insert elements 1 consist of perforated sheet material. The material is bent into sheet portions 2 so that the elements have various shapes. In this connection Figures 1—5 show possibilities of the bending. The various shapes can be assembled as desired from the simple basic form shown in Figure 1. Figures 1—5 do not show the additional passage openings formed by flaps since these Figures are only concerned in showing possibilities of shape for the insert elements. Additional passage openings 5 formed by means of flaps 3 may be seen from Figure 6. The form of the flaps according to Figure 6 can have various shapes and sizes. Thus each insert element 1 has passage openings 5 in addition to perforations indicated generally in Figure 6 by diamond cross hatching. The flaps 3 are arranged to point in the same direction for each sheet portion and at an acute angle 4 to the sheet portions 2 so that in projection on the horizontally lying insert element 1 the produced additional passage openings 5 have their corresponding flaps lying above them. Figure 6 shows an arrangement of the additional passage openings 5 and the flaps 3 in an insert element 1 in symmetrical sequence. It is also possible to arrange these additional passage openings 5 and flaps 3 asymmetrically in relation to other openings and flaps in the same insert element.

Figures 7 and 8 show an embodiment of perforations 6 in detail of an area X shown in Figure 6. The perforations 6 are orientated directionally so that passage openings formed thereby are directed in a specific direction.

By combination of a plurality of insert elements 1 in the horizontal and vertical directions a complete column packing is produced. Figure 9 shows the arrangement of several insert elements 1 side-by-side corresponding to Figure 6, the flaps 3 of the sheet material 2 of the adjacent insert elements 1 not being in alignment with one another in one direction across the insert elements. It is especially advantageous to arrange the insert elements 1 so that the flaps 3 of adjacent horizontal elements are staggered with respect to one another and, if of suitable size, interlock one between two others to minimize shifting of the insert elements 1 with respect to one another within this horizontal layer. The direction of orientation of the perforations varies from insert element 1 to insert element 1 as may be seen

from Figures 10 and 11; a variation of direction of orientation of the perforations within an insert element 1 is also realisable, according to the manner of perforating the sheet material. The insert elements 1 arranged parallel in rows horizontally form a layer. The column packing is completed by packing a plurality of layers one above the other. The longitudinal axes of the insert elements 1 of adjacent layers extend at angles of 0—90° to one another. In Figure 12 this angle is 90°. Figure 13 represents one particular form of embodiment. By reason of the loose arrangement of the adjacent insert elements 1 this packing renders possible still greater throughputs, and here free falling through of droplets is prevented. In contrast to all the insert elements 1 represented hitherto, the flaps 3 of the sheet portions 2 in Figure 14 are pressed downwardly. The longitudinal axes of the insert elements 1 of adajacent layers extend parallel with one another and the profiles according to Figure 1 are joined together in each case to form a quadrangle.

The manner of operation of the heavy-duty exchangeable packing according to the invention is as follows:

With the setting in operation of the column in, for example, rectification, the entire packing is wetted by the rising and condensing vapours and by the return liquid charged upon the packing. The liquid is conducted downwards in uniform distribution by the design and arrangement of the insert elements 1 according to the invention, without the occurrence of unwetted regions or heavily liquid-charged zones. The flaps 3 prevent the free fall-through of liquid droplets.

Gas or vapour in passing through the packing travels from below upwards both through the perforations 6 and through the additional passage openings 5. Due to the additional passage openings 5 provided by the flaps 3 an additional eddying of the phases occurs, whereby the gas or vapour current cannot rise vertically upwards without hindrance, but constantly changes its direction of movement.

WHAT WE CLAIM IS:—

1. Heavy-duty exchangeable packing for gas or vapour and liquid contact columns, comprising layers of horizontally arranged parallel insert elements which are perforated, bent sheets having sheet portions at an angle to each other, the layers of sheets being packed one above the other in layers, the perforations being elongated along an axis and being orientated in direction on each sheet, either all in the same direction of orientation or in different directions of orientation the sheet portions being provided with flaps cut therefrom, the flaps being bent from the plane of their respective sheet portions in similar directions at similar acute angles, whereby additional passage openings are produced in the sheet, the additional passage openings being provided so that the flaps for each sheet portion point in the same direction wherein the direction or directions of orientation of the perforations on one sheet is different from the direction or directions of orientation of the perforations on the next adjacent sheet.

2. Heavy-duty exchangeable packing for columns according to claim 1, wherein the area of the flaps of the sheet material amounts to 20% to 50% of the total area of the sheet material.

3. Heavy-duty exchangeable packing for columns according to claim 1 or 2, wherein the shapes of the flaps are rectangles, triangles or semi-circles.

4. Heavy-duty exchangeable packing for columns according to any one of the claims 1 to 3, wherein the acute angle of the flaps with the respective sheet portion lies in the range of 15 to 90°.

5. Heavy-duty exchangeable packing for columns according to any of the preceding claims, wherein all the perforations in one sheet portion have the same direction of orientation.

6. A heavy duty exchangeable packing for gas or vapour or liquid contact columns, substantially as described herein with reference to and as illustrated by the accompanying drawings.

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1341981 COMPLETE SPECIFICATION
5 SHEETS

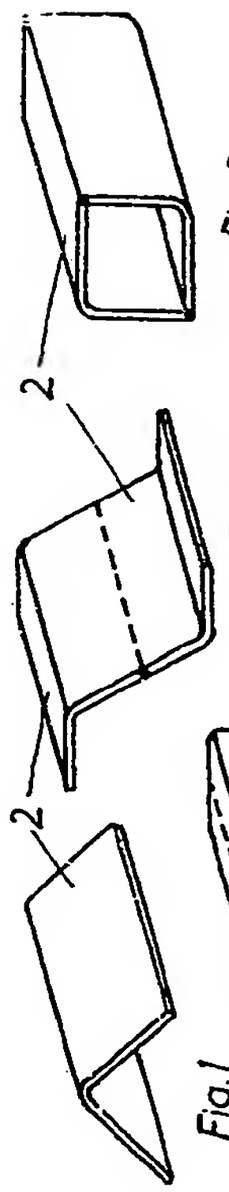

Fig.3

Fig.2

Fig.1

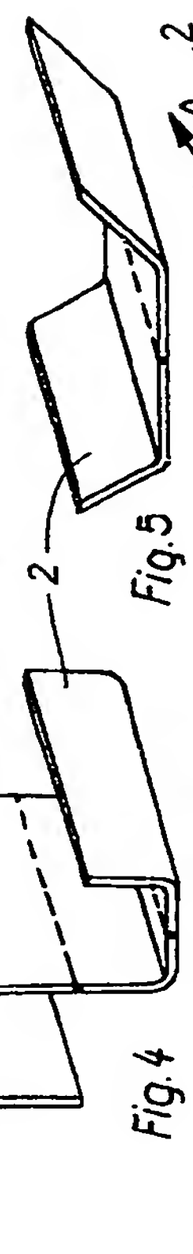

Fig.5

Fig.4

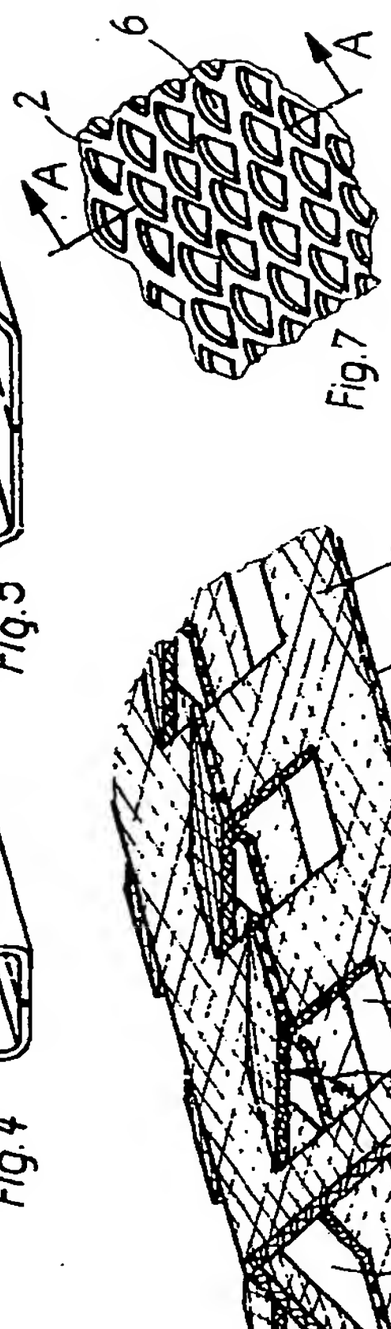

Fig.7

Fig.8

Fig.6

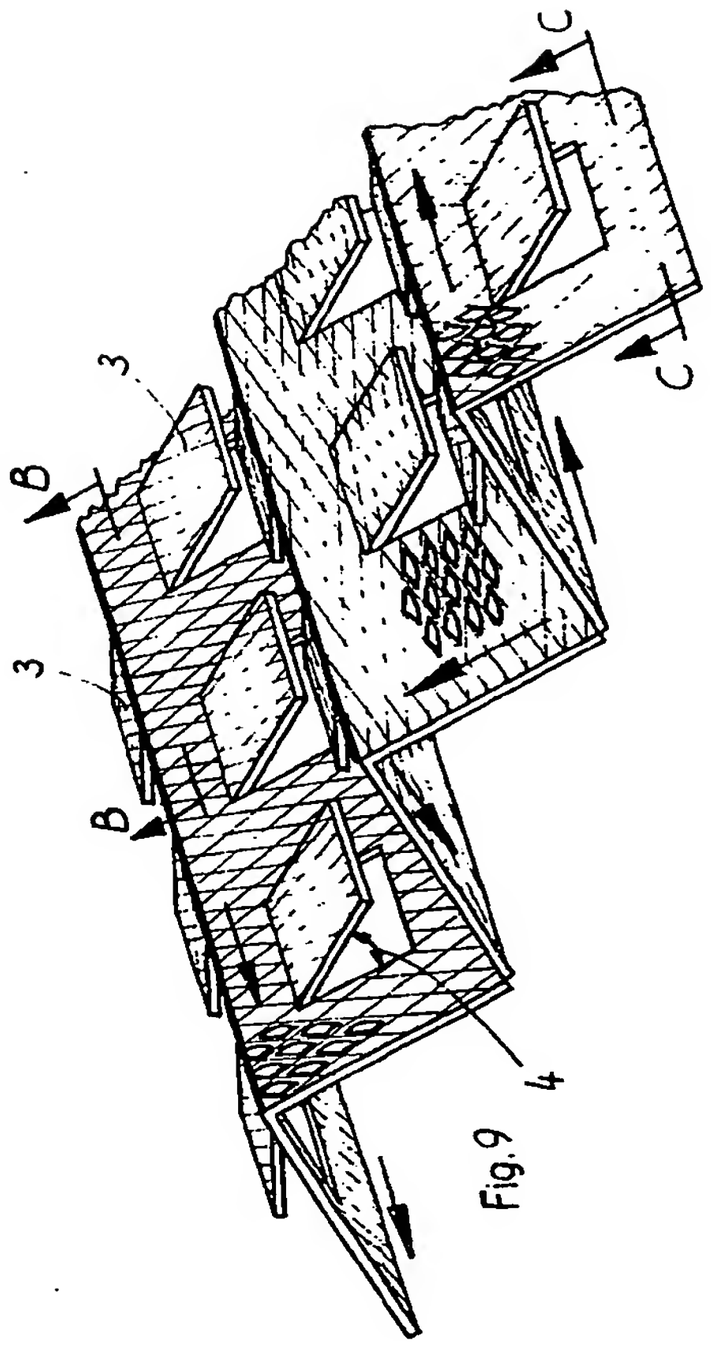

Fig.9

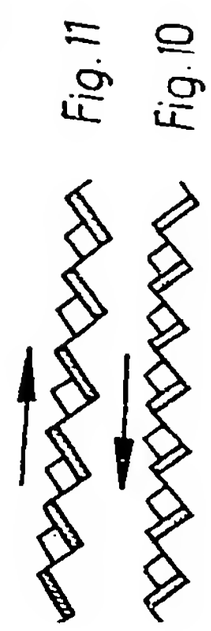

Fig.11

Fig.10

1341981 COMPLETE SPECIFICATION
5 SHEETS *This drawing is a reproduction of the Original on a reduced scale*
Sheet 3

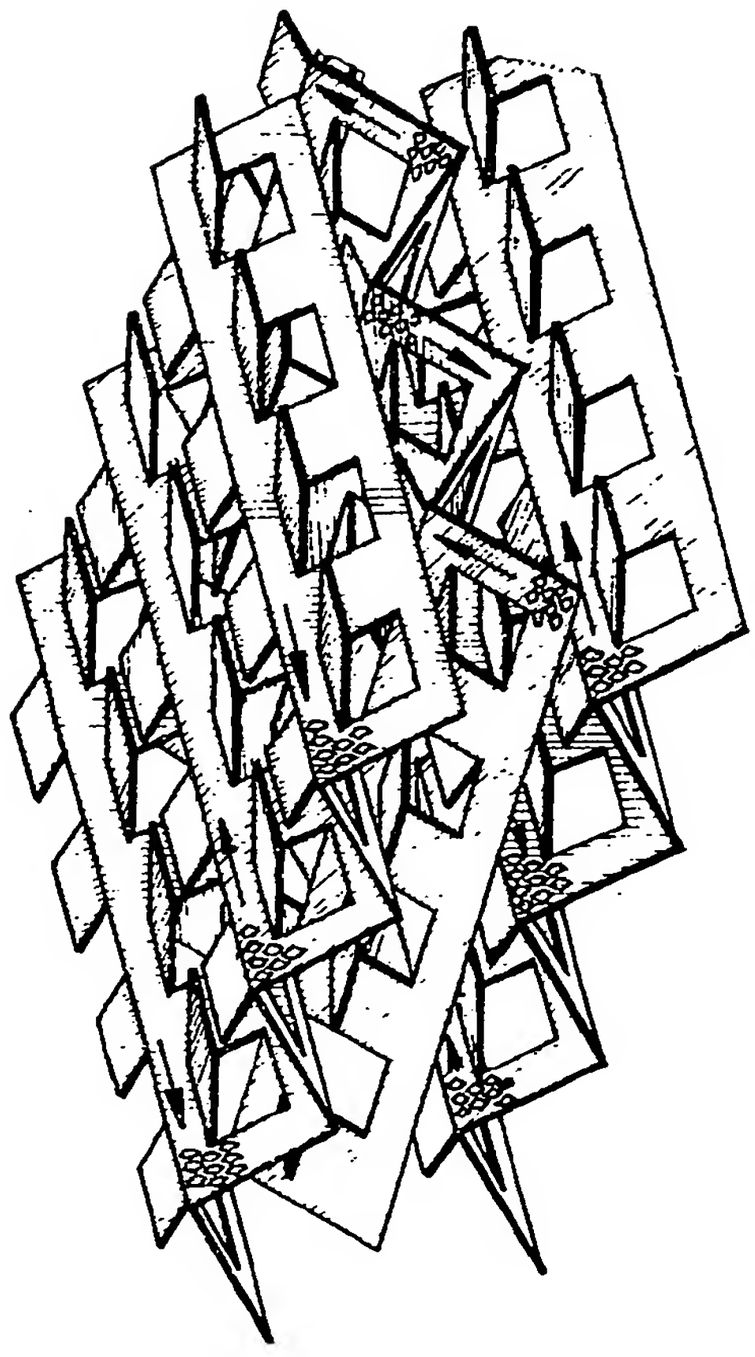

Fig. 12

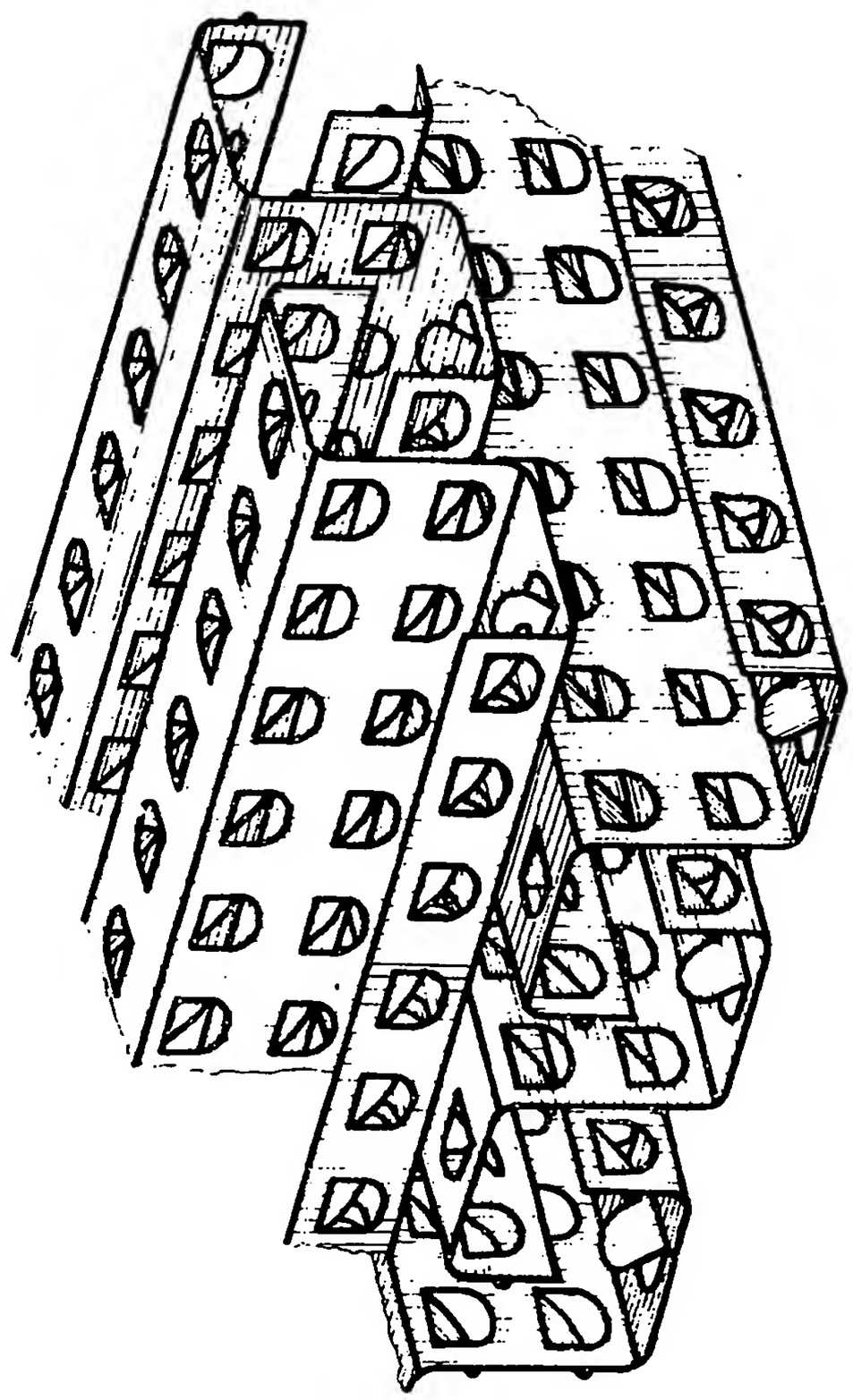

Fig. 13

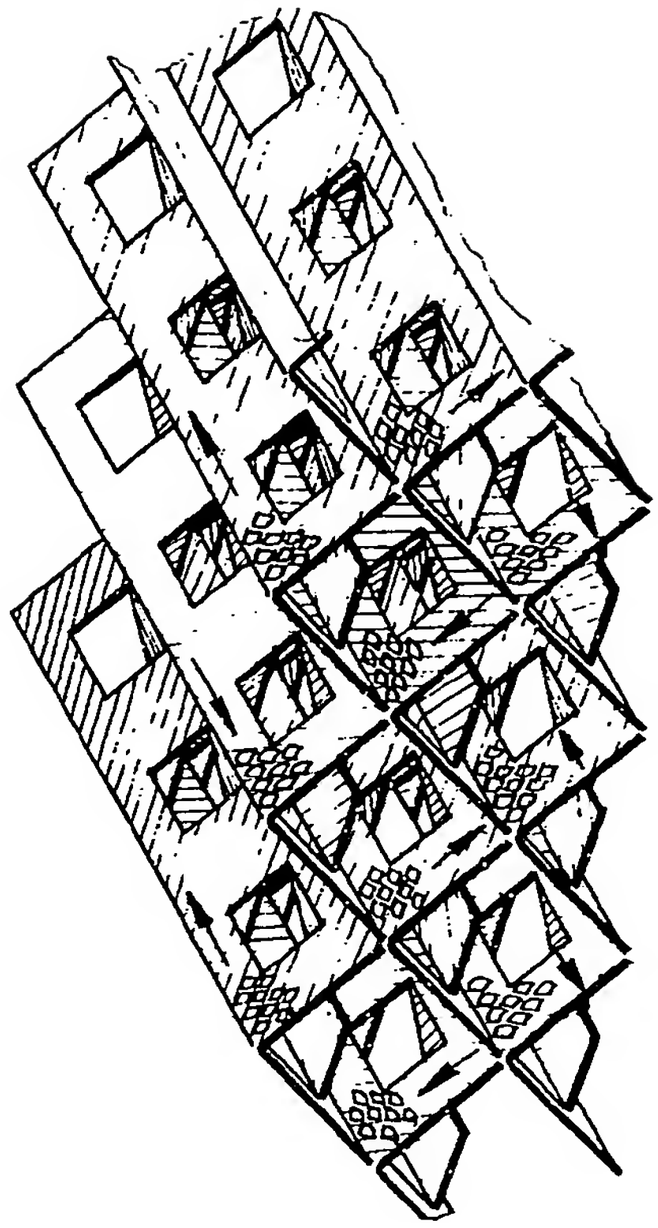

Fig. 14